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Metallogenetic Sources of the Skarn Cu Polymetallic Deposits in the Southern Bangonghu-Nujiang Metallogenic Belt, Western China: Constraints from S and Pb Isotopes

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The Bangonghu-Nujiang suture zone (BNSZ) was formed in response to closure of the Tethys Ocean. Numerous medium- to large-sized skarn Cu polymetallic deposits have been discovered in the southern Bangonghu-Nujiang suture zone, such as Galale, Gaerqiong, Shesuo, and Bangeria. These deposits are generally distributed in the contact zone between Cretaceous granitic intrusions and limestone, marble, or dolomite from the Early Cretaceous Langshan and Duoai formations.

The orebodies are mainly veined, stratoid, or lentoid. Ore minerals are dominated by chalcopyrite, bornite, malachite, chalcocite, azurite, magnetite, and pyrite, with accessory galena and sphalerite. A certain amount of native gold and electrum has also been detected in the Galale and Gaerqiong deposits. The ore-related wall-rock alteration consists mainly of skarnization, silicification, and hornfelsic alteration.

The Shesuo, Galale (Gaerqiong), and Bangeria deposits yield ore-forming ages of 116, 88, and 80 Ma, respectively, representing an evolution from subduction, collision, to postcollision tectonic environment. We conducted a detailed S and Pb isotope study for these deposits in an attempt to characterize the sources of ore-forming materials. The $\delta^{34}S$ values of 39 sulfide separates from Shesuo vary from –10.3‰ to 2.7‰ (average –3.8‰), which can be explained by mixing between stratum and mantle. The $\delta^{34}S$ values of Galale (four sulfides) and Gaerqiong (16 sulfides and one anhydrite) vary from –4.4‰ to +1.5‰ (average –0.6‰) and –2.9‰ to +11.8‰ (average +0.6‰), respectively, indicating a mantle source. The $\delta^{34}S$ values of five sulfide separates from Bangeria vary from –0.6‰ to +5.0‰ (average 2.8‰), indicating an origination from mantle with few stratum inputs. In summary, the ^{34}S values became gradually enriched from the oceanic crust subduction stage through the plate collision stage to the postcollisional stage.

The sulfides from the Shesuo deposit display $^{206}Pb/^{204}Pb$, $^{207}Pb/^{204}Pb$, and $^{208}Pb/^{204}Pb$ values of ~18.517 to 18.831, ~15.671 to 15.807, and ~38.955 to 39.520, respectively, which are characteristic of the upper crust lead. Sulfides from the Galale and Gaerqiong deposits yield $^{206}Pb/^{204}Pb$, $^{207}Pb/^{204}Pb$, and $^{208}Pb/^{204}Pb$ values of ~17.881 to 18.615, ~15.543 to 15.725, and ~38.010 to 39.134, respectively, indicating a mixture of crust-mantle materials. Sulfides from the Bangeria deposit exhibit $^{206}Pb/^{204}Pb$, $^{207}Pb/^{204}Pb$, and $^{208}Pb/^{204}Pb$ values of ~18.612 to 18.677, ~15.648 to 15.737, and ~38.882 to 39.147, respectively, indicating a lead source from the upper crust.